Implementation of Powdered Activated Carbon with Ultrafiltration for Micropollutants Removal and Elimination of Antibiotic Resistant Bacteria, Viruses and Genes

The effluent of the sewage treatment plant is an important entry path of the micropollutants into the water body. For the removal of micropollutants from the wastewater treatment plant, three technologies have been established: ozonation, powdered activated carbon (PAK) and granulated activated carbon (GAK).

Antibiotic-resistant bacteria (ARB) have a direct impact on human health. The significance of the various entry paths (effluent of the sewage treatment plant, agriculture, mixed water drainage) has not yet been adequately investigated. It is undisputed that ARB, viruses and resistance genes also get into the environment through the effluent of the sewage treatment plant.

Due to its pore size of less than 0.1 μm, ultrafiltration (UF) is a natural barrier for bacteria. The first extensive studies prove the effective reduction of pathogens by ultrafiltration. It should be noted that the reduction efficiencies also depend on the process parameters used. It is also important to consider whether the antibiotic resistance genes are retained by ultrafiltration. The scope of this project is to investigate whether besides the removal of micropollutants with the combination process of powdered activated carbon and ultrafiltration, any effective removal of the ARB or their genes and viruses can also be achieved.

The project is intended to answer the following questions:

- Is the use of a UF-stage with an upstream PAC dosage economically feasible for the biologically treated wastewater?
- How often must the UF be cleaned or how does the pressure loss change during operation?
- Which PAC dosage is necessary for the removal of micropollutants, taking into account the contact time and the separation unit?
- Are the antibiotics-resistant bacteria or resistant genes reliably removed?
- Estimation of the total costs to be applied for this technology compared to conventional targeted treatment stages for the elimination of micropollutants

The pilot plant will be installed at the Tuttlingen sewage treatment plant and will be provided by Strecker Wassertechnik GmbH. Figure 1 shows the procedural concept of the test setup.

![Image](image_url)

**Figure 2: Ultrafiltration plant of the company Strecker Wassertechnik GmbH**

The test facility consists of a PAK dosing unit and the ultrafiltration module (see Figure 2). The PAC dosing is carried out by means of a dosing pump, which takes the PAC mixture from a batch container and doses it into the feed of the ultrafiltration module.

As part of the investigations, the influent and effluent of the pilot plant are analyzed for micropollutants as well as for relevant bacteria, viruses and genes. In addition, the influent of the sewage treatment plant and the effluent of the existing filter as well as the extraction of the ultrafiltration unit should also be examined in order to be able to carry out an overall assessment of the sewage treatment plant and a comparison of the process technologies (PAK-UF vs. filter). These samples are taken over the span of a year to consider seasonal influences.

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